Remarks

Amendments to the Drawings

In accordance with the suggestion by the Examiner, Figure 1 has been deleted. Figures 2-16 have been renumbered Figures 1-15. Replacement drawing sheets 1-17 are appended to this paper.

The drawing sheets have also been amended to conform to drawing protocols as to the figure numbers as follows:

On replacement sheet 2/17, (a), (b), (c), and (d) have been amended to: Figure 2A, Figure 2B, Figure 2C and Figure 2D, respectively.

On replacement sheet 11/17, **a**, **b**, and **c** have been amended to: Figure 10A, Figure 10B, and Figure 10C, respectively.

On replacement sheet 11/17, **a** and **b** have been amended to Figure 15A and Figure 15B, respectively.

No new matter has been introduced in the replacement drawing sheets.

Amendments to the Specification

The BRIEF DESCRIPTION OF THE DRAWINGS section has been amended to conform the descriptions of the drawings to the drawings as renumbered as a result of deleting Figure 1.

Page 29, line 3, has been amended to correct a typographical error, namely, "Table 2" has been changed to "Table 3".

All of the remaining amended paragraphs in the specification have been amended to conform the specification to the new figure numbers as a result of deleting Figure 1, including deleting the references to Figure 1 at page 34, line 18, and at page 35, lines 9/10.

No new matter has been introduced in the amendment to the specification.

The drawings are objected to under 35 C.F.R. 1.83(a). The Examiner objects to Figures 1-1c and

9a as lacking clarity from their lack of relevant structural description in the specification. Applicant disagrees with this characterization of Figures 1-1c. However, in order to expedite prosecution, applicant has deleted Figures 1-1c and reference to such figures from the specification.

Applicant disagrees with the objection to Figure 9a. It is submitted that Figure 9a is a schematic representation of the apparatus as claimed. It includes an inlet and outlet for the organic phase and an inlet and outlet for the aqueous phase. Example 7 describes the structural materials of the elements of the microfluidic device. It is clear from the specification that the aqueous phase corresponds to the liquid sample stream and that the organic phase corresponds to the carrier liquid stream. As described, these two streams form a liquid-liquid interface as described. It is clear that the microfluidic device of Figure 9a contains the flowing liquids which form part of the claimed invention. Accordingly, applicant requests that the objection to Figure 9a be withdrawn.

Claims 1-11 are rejected under 35 U.S.C. 112, ¶ 2, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner states that it is unclear what constitutes a "liquid sample stream wall" and a "carrier liquid stream wall." The Examiner questions whether the claim recites structure of the flow-through treatment channel, which would provide that only the respective streams touch respective wall by this limitation. If so, the Examiner states that applicant must establish structural elements and relationships within the flow-through treatment channel for such flow and contact of the two streams. The Examiner further states that applicant does not establish a liquid sample and carrier sample in the claims.

In response to the foregoing rejection, applicant has clarified Claim 1 to recite a liquid sample stream having at least one analyte ion species and matrix ion species flowing through the housing in contact with the liquid sample stream wall but out of contact with the carrier liquid stream wall and a carrier liquid stream flowing the housing in contact with the carrier liquid stream wall but out of contact with the liquid sample stream wall. This amendment to Claim 1 overcomes the foregoing rejection under 35 U.S.C. 112, ¶ 2.

The Examiner notes that the preamble recites elements not recited in the body of the claim. While applicant disagrees with the necessity of doing so, such elements are now recited in the claim body.

The Examiner notes the inconsistent use of "generally parallel" and "substantially parallel." Claim 1 has been amended to recite only the phrase "substantially parallel." Further, Claim 1 has been

amended to recite that a liquid sample stream and carrier liquid stream are disposed in the treatment channel in substantially parallel flowing streams.

The Examiner states that it is unclear how a substantially lower concentration in the liquid sample stream at the channel outlet then at the channel inlet exists without establishing a matrix ion species in the sample stream and without establishing a concentration in the sample stream with which to make a comparison. Claim 1 has been amended to recite a matrix ion species within the sample stream and that such matrix ion species is present as a first concentration at the treatment channel inlet to form the basis for the comparison.

Finally, with respect to the Section 112, ¶2 rejection of Claim 1, the Examiner notes that the term "said parallel streams" lacks antecedent basis in the claim. Claim 1 has been amended to recite "said substantially parallel liquid streams" which has antecedent basis. Further, the Examiner states that the term "said carrier liquid stream" does not have antecedent basis. Claim 1 now recites a carrier liquid stream at the first occurrence providing such antecedent basis.

The Examiner notes that Claim 2 recites a detector for said one analyte ion species and notes there is no antecedent basis of such a term in the preamble of Claim 1. Claim 2 has now been amended to recite a detector for said at least one analyte species, which is recited in Claim 1.

The Examiner rejects Claims 11 and 27 based on use of the term "substantially planar." To expedite prosecution, Claims 11 and 27 have been canceled.

Claim 16 has been rejected on the basis of recitation of the term "said treating step." Claim 16 has been amended to delete "treating step" and substitute "treating method".

The Examiner rejects Claims 23 and 24 and their recitation that the liquid interface is disclosed substantially horizontally and horizontally vertically, respectively. Applicant does not understand this rejection. Claims 23 and 24 are method claims and so the horizontal and vertical disposition of the liquid interface is all that is necessary to define the method. Applicant does not understand why it is necessary to recite the disposition of the apparatus. The Examiner specifically states that the horizontal and vertical disposition being claimed is not relative to any certain aspect so as to give a particular structural orientation. Again, the structure does not form part of this method limitation. The terms "vertical" and "horizontal" are well recognized terms which describe their aspects relative to the Earth.

Claims 1, 2, 4-9, 11-21, and 23-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Yager (5, 971, 158). Yager discloses diffusion of the analyte particles from the sample stream into the reagent stream for detection. In contrast, instead of removing the analyte from the sample stream as set forth in Yager, the present claims recite removing a matrix ion species from the sample stream into a carrier liquid stream, which includes a matrix ion species capture material. The objective of Yager is to remove the analyte from the sample stream into the carrier liquid stream and to detect the analyte in the carrier liquid stream. The purpose of removing the analyte particles is to isolate them from the surrounding contaminant materials in the sample by transporting sample into the carrier liquid stream. For example, as set forth at column 18, lines 53-57, one application is to detect urea from blood by transporting the urea into the carrier liquid stream and detecting the carrier liquid stream.

The Examiner asserts that Yager discloses that the invention may be utilized as a sample pretreatment system for an analytical system including sensing means for detecting desired particles in the product and by-product streams. Applicant does not dispute the Examiner's assertion that at least a portion of the analyte ion species intended to be transported across the liquid-liquid interface could be present in the sample stream. However, this does not mean that Yager teaches detecting the analyte ion species in the sample stream. To the contrary, Yager teaches in the exact opposite direction. The entire objective of Yager is to transport the analyte ion species into the carrier liquid stream for detection in that stream free of the remaining large particle contaminants in the sample liquid stream, which would interfere with such detection of the analyte ion species in the carrier stream. If Yager intended to detect the analytes in the liquid sample stream, there would be no reason to use the Yager liquid-liquid interface system to isolate the analyte ion from other components in the liquid sample stream by transfer to the carrier liquid stream. Thus, Yager teaches away from analyzing the analytes in the liquid sample stream. With the foregoing in mind, it is submitted that Claim 1 clearly differs from the prior art. Moreover, Claim 2, recites a detector for the at least one analyte ion species in the sample stream and a fluid conduit providing fluid communication between the sample treatment outlet and the detector with the sample stream flowing through the conduit. This provides an additional significant difference from Yager. Similarly, like Claim 2, it is submitted that Claims 14 and 15 clearly distinguish from Yager. Claim 14 recites that the analyte ion species is detected in the sample stream and Claim 15 recites that the sample stream and carrier liquid stream exiting the treatment channel are separated prior to detection.

Claims 1-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rocklin (4, 751, 189) in view of Yager.

Rocklin discloses a suppressor with a sample liquid stream on one side of an ion exchange membrane and a carrier liquid stream on the other side. Elimination of the ion exchange membrane in a suppressor is an important feature of the present invention with a number of advantages. It greatly simplifies construction of the pretreatment device. As set forth in the Background of the Invention at page 2, lines 8-14 of the specification, it is difficult to mass fabricate low-cost devices incorporating such membranes due to sealing and fabrication issues. Further, the claimed invention permits a simplified construction of a micro-device which could be used for suppressed capillary ion chromatographic applications, e.g., including a portable briefcase-sized unit, as further set forth in the background of the present invention. Thus, the present invention has significant applications not disclosed in Yager. Further, as the Examiner recognized, another difference from Rocklin is that Rocklin does not disclose a matrix ion species capture material in the carrier stream or any reason for the inclusion of such material.

Applicant's remarks regarding Yager have been discussed above.

The Examiner asserts it would be obvious to modify Rocklin to include a sequestering material in the carrier liquid stream to provide a means for increased diffusion of the desired particles while no longer requiring the added elements of the ion exchange membrane in the flow channels. However, Yager is directed to the solution of an entirely different problem using an entirely different approach in comparison to the invention of the present claims. As set forth above, Yager removes the analyte ions from the sample liquid stream to the carrier liquid stream for detection to free it from contaminants in the sample liquid stream. In contrast, Rocklin removes matrix ions across an ion exchange membrane while detecting the sample liquid stream. There is no suggestion of modifying Rocklin to use the liquid-liquid interface of Yager, which teaches a different method performed for a different purpose.

Claims 9 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yager in view of Cais. Applicant's foregoing comments regarding Yager incorporated this point.

The Examiner concedes that Yager does not disclose immiscible sample stream and carrier liquid stream. The advantages of using immiscible sample and carrier liquid streams are set forth at pages 10-12 of the specification. At page 10, lines 1-9, the specification teaches continuous and near quantitative ion exchange for suppression using immiscible liquids. At the bottom of page 11, the advantage of immiscible phases for a liquid ion exchanger is highlighted. There is no suggestion in Cais of such advantages of using immiscible liquids. Thus, it is submitted that the claims distinguish from these disparate prior art references.

For the foregoing reasons, it is submitted that the claims are now in condition for allowance.

The Commissioner is authorized to charge fees which may be required, including extension fees, or credit any overpayment, to Deposit Account No. 500310..

Please direct any calls in connection with this application to the undersigned at (415) 442-1174.

Respectfully submitted,

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